

## **Biosystematic Studies on the Marine Fouling Invertebrates in Korea — A Systematic Study on the Ascidians from Chundo Island (Onsan Bay), Korea —**

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### **ABSTRACT**

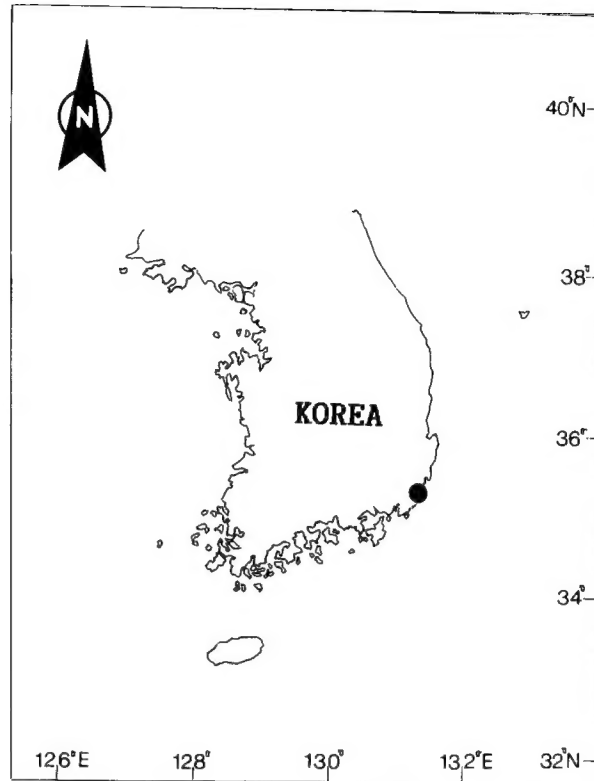
The ascidians of Chundo Island are identified into 15 species, 8 genera, 6 families. Among them two species are found to be new to Korean fauna. They are *Ascidia sydneyensis* Stimpson and *Ascidia zara* Oka. They are described with figures, and the other species are provided with remarks.

Key words: Systematics, ascidians, Chundo Island, Korea.

### **INTRODUCTION**

A systematic study on the ascidians from Chundo Island was conducted by Biosystematic studies on the Marine Fouling Invertebrates in Korea (BSRI-95-4421, SCUBA Team). The collecting of the specimens was done during the period February and June 1995, and February 1996 at Chundo Island (Onsan Bay, 29°21' 17"E, 35°16' 47"N) (see Text-fig.1). Chundo Island has been affected by industrial progress. The specimens were collected by qualitative and quantitative sampling methods from depths ranging from the intertidal zone to 10 meters. All the specimens were relaxed by menthol powders for several hours and then fixed in solution of 4-5% formaldehyde and water. To observe the internal structure of the animals, they were kept in a solution which was composed of 1% chromic acid and 50% acetic acid in a 1:10 ratio for a day. Next they were placed into a solution of 1% chromic acid for a few hours before dissecting. Their dissected halves were observed.

The system of classification in the present work followed that used by Van Name (1945) and in part those adopted by Kott (1985) and Nishikawa (1990, 1991). The identified specimens are described briefly with illustrations provided for each species, and the previously recorded species are



**Text-Fig. 1.** Map showing the locality where the presented materials were collected.

provided with "Remarks". The collected materials are kept at the Department of Biological Science, Ewha Womans University, Korea, and the asterisks indicate the ascidian species which are new to Korea.

## SYSTEMATIC ACCOUNTS

Class Ascidiacea 해초강

Order Enterogona Perrier, 1898 내성해초목

Suborder Aplousobranchia Lahille, 1886 무관아목

Family Didemnidae Verrill, 1871 흰덩이멍게과

### 1. *Trididemnum savigney* (Herdman, 1886) 세줄흰덩이멍게

*Didemnum savignii* Herdman, 1886, p. 261, pl. 34, figs. 1-5.

*Trididemnum savignii*: Van Name, 1921, p. 314, figs. 7-9; Kott, 1981, p. 184-186, figs. 33a, b; 37; Tokioka, 1953, p. 197; Nishikawa, 1990, p. 112.

**Material examined.** 4 colonies, Chundo, 26 July 1995, by divers, 2 m depth.

**Remarks.** This ascidian forms incrusting sea weeds, large and massive, 70 x 30 mm or 60 x 40 mm in extent and up to 20 mm thick, and each consists of several mammillary processes. There is not common cloacal aperture at the end of each process, the lacuna are well developed at thickened portions of the colonies and the axial portion of the colony beneath these lacunae is occupied by

well-defined core matrix. The mammillary processes and other parts are from dark, white or grayish blue to faint milky white in color.

Test is soft, gelatinous, translucent or quite transparent in the colonies. The external appearance of the colony is greatly distributed of the large stellate spicules and the abundance of the pigment cells in the test. The spicules are of comparatively large size, 42  $\mu\text{m}$  in diameter or even more. They are regular in form, being stellate, with numerous conical points. The spicules are chiefly or entirely confined to a layer in the test a little beneath the upper surface. They are often distributed in this layer in groups or patches, 124  $\mu\text{m}$  x 99  $\mu\text{m}$  in extent, and found more densely around respective branchial apertures so that apertures are seen as white spots to the naked eye.

Zooids are colorful, dark smoky brown or blackish color in present of the zooids, especially about anterior of the thorax and sometimes on the abdomen. In the preserved material, they vary from 1.6 mm to less than 1 mm in length, this being largely dependent on the state of contraction they are in branchial aperture with six short lobes. Atrial aperture also six lobed in some zooids, situated on the dorsal side of the thorax about the middle or somewhat farther toward the posterior end, the position varying in different colonies and also in different zooids of the same colony. Mantle has well-developed longitudinal muscle bands on the thorax, tentacles about eight in number, of at least two size arranged alternately and branchial sac with three rows of stigmata. The number in a row on each side, 8-10 in each of three rows.

One testicular follicle, proximal portion of vas deferens coils 6 to 7 times or more, about the large conical testis and there are one egg.

**Distribution.** Korea (Korea Strait); Japan (Honshu); Philippine Is.; Palaw Is.; Marianas Is.; Hawaiian Is.; Cape of Good Hope (150 fathoms); Bermuda; Florida; Salinas Cove; South coast of Puerto Rico; Charleston; South Carolina; Cedon Keys to off Key West; Jamaica.

Suborder Plebobranchia Lahille, 1886 편새아목

Family Cionidae Lahille, 1887 유령멍게과

## 2. *Ciona intestinalis* (Linnaeus, 1767) 유령멍게

*Ascidia intestinalis* Linnaeus, 1767, p. 1087.

*Ciona intestinalis*: Trausted, 1886, p. 424.

For other synonyms and references see Rho (1995, p. 130).

**Material examined.** 2 specs., 14 Feb. 1995, by divers, 1 m depth; 41 specs., 26 July 1995, by divers, 1-3 m depth; 3 specs., 3 Feb. 1996, by divers, 2 m depth.

**Remarks.** The largest one is 45 mm in long and 20 mm in width. They are quite identical with the previous description of *C. intestinalis* given by Rho (1995), where the specimens were collected from Chindo Islands.

The test is very soft and flabby condition, and more or less transparent. The both siphons are terminal with six lobes and six orifice with red spots about its margin. The musculature of the mantle usually consists of six longitudinal bundle nearly the whole length of the body, and tentacles simple, with 13 in number and the anus with 12 lobes. The gonads are well developed and the tubular oviduct which accompanies the rectum, and the testis consist of a great number of small, or more or less lobed glands and extended all over the intestinal loop and stomach.

*Ciona intestinalis* is a cosmopolitan species which has been recorded from most parts of the

world, even from tropical waters. They lies in shallow water from the tidal zone to not deeper 100 m, though it has been taken from water of as much as 5 m in the coastal seas of Korea. The speices occurs on various bottom, in the shallow water it is usually attached to algae, oyster shells, and the break waters. Most of the present species are frequented by ships and it has therefore been suggested that the species is not to be regarded as an endemic species, but rather as an immigrant species by ships.

**Distribution.** Korea (East Sea, South Sea, Korea Strait); Japan; China Sea; Suez and Singapore; Australia and the Strait of Magellan; New Zealand; N. America to South California; southern Alaska and Canada; Faroe Island and Mediterranean; Denmark Strait; Rio de Janeiro; cold temperature to warm temperature waters of Europe: Cosmopolitan species.

Family Ascidiidae Herdman, 1887 대추멍게과

**\*3. *Ascidia sydneyensis* Stimpson, 1855** 꾸러기대추멍게(신칭) (Figs. 1-3)

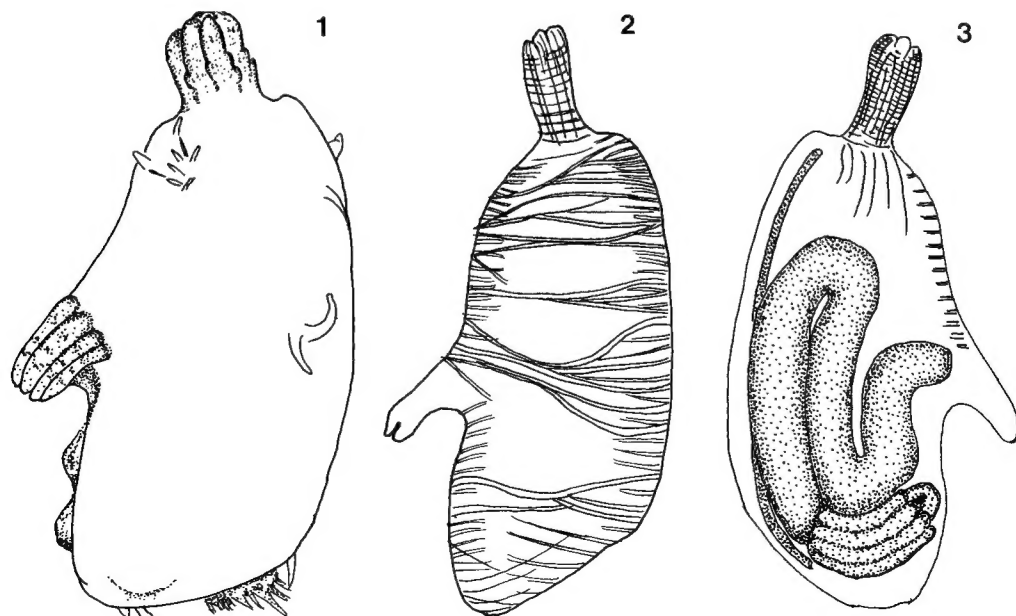
*Ascidia sydneyensis* Stimpson, 1855, p. 387; Van Name, 1930, p. 468, fig. 39; 1945, p. 189, text-fig. 101; Tokioka, 1952, p. 105, fig. 10; 1953, p. 223; Kott, 1972, p. 24, figs. 37-38; 1980, p. 526, fig. 14; 1985, p. 54, fig. 21, pl. 1d; Millar, 1975, p. 271, fig. 53; Kott & Goodbody, 1980, p. 526, fig. 44; Nishikawa, 1991, p. 38.

*Ascidia canaliculata*: Herdman, 1891, p. 593; Sluiter, 1898, p. 41, taf. 5, figs. 15-18; Michaelsen, 1918, p. 59.

*Ascidia compta*: Sluiter, 1898, p. 43, taf. 5, figs. 19-21, taf. 6, fig. 1.

*Phallusia sydneyensis*: Van Name, 1921, p. 386, figs. 62-65.

*Ascidia sydneyensis divisa*: Tokioka, 1953, p. 226, pl. 34, figs. 1-5; 1954, p. 84, pl. 6, fig. 17; Rho, 1971, p. 111; 1975, p. 131; Nishikawa, 1980, tab. 1.



**Figs. 1-3.** *Ascidia sydneyensis* Stimpson, 1855: 1, entire animal from right side, natural size; 2, right side of mantle body, 30 mm long individual; 3, left side of mantle body, same specimen.

For other synonyms and references see Van Name (1945), Tokioka (1953), Kott (1985) and Nishikawa (1991).

**Material examined.** 3 specs., 14 Feb. 1995, by divers, in sandy-mud, 2-5 m depth; 1 spec., 3 Feb. 1996, by divers, 5 m depth.

**Description.** Body commonly elongate and large specimen up to 90 mm long and 40 mm in width. The others 30 mm x 15 mm in extent and laterally flattened, and posterior end broad and slightly rounded. Both siphons not short, moderately size, usually six lobes with fringed and six ocelli between them. Branchial siphon terminal and atrial ones about one-third of body length distant from it and atrial siphon turned posteriorly in small one. Test thin, translucent but in large specimens moderately thick and firm. Right side of mantle body having a border of short, stout, parallel transverse muscle bands and center of right side without above such muscle bands, and whole left side of mantle body thin, transparent and nearly free from muscles.

Branchial tentacles 50 or 35 in number with large filiform, and rarely small ones, dorsal tubercle filling V-shaped peritubercular area and having a complex convoluted to interrupted slits. Dorsal lamina with a nearly plain and tooth edge rolled on the left. Branchial sac not extended, its anterior part narrow, posterior part broad. Internal longitudinal vessels are 30-72 in number of the transverse vessels of middle part of body. Four to five stigmata in a mesh, and parastigmatic vessels seldom present. Branchial papillae large much bent or hooked. Digestive tract fairly large, deeply curved and narrow loop, and covering most of posterior half of left side and stomach rather small.

Reproductive organs crowded together in gut loop and surface of alimentary canal covered densely with testicular follicles.

**Remarks.** Tokioka (1953, p.223; 1967, p.399) divided them into three groups by the different position of anterior margin of alimentary canal in relation to the atrial siphon of mantle body. According to his grouping, our *Ascidia sydneyensis* belongs to the group 1 and the dorsal tubercles complex. The ciliated groove increases in complexity with increasing size in *Ascidia sydneyensis*, as mentioned by Van Name (1945), Millar (1975) and Kott and Goodbody (1980), and then "anterior margin of alimentary canal can be regarded as a series of individual variations" (Nishikawa, 1991, p. 39) in *samea* and *divisa*, subspecific taxa of *A. sydneyensis*. The present authors agree with the opinion above such mentioned. The present species is first described in Korea.

**Distribution.** Korea (Korea strait); Japan; Hong Kong (Ping Chau); widely distributed in the tropical seas to warm temperate waters around the world.

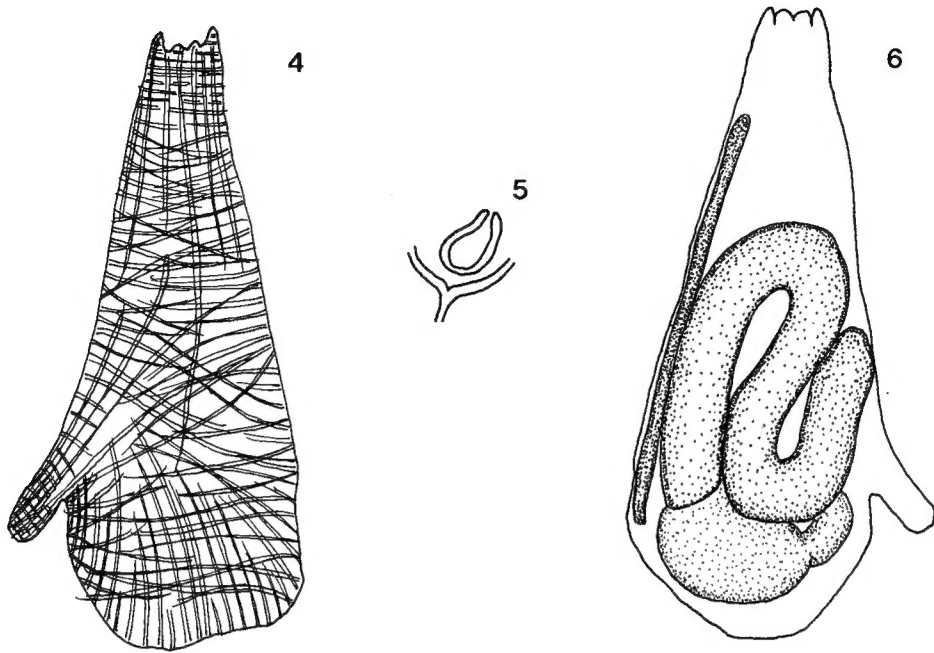
#### 4. *Ascidia gemmata* Sluiter, 1895 흑대추멍게 (Figs. 4-6)

*Ascidia gemmata* Sluiter, 1895, p. 177, pl. 9, figs. 7-9.

*Ascidia gemmata*: Tokioka, 1950, p. 131, fig. 11; 1952, p. 103, text-fig. 9; 1961, p. 107, text-fig. 3; 1967, p. 140, fig. 51; Rho, 1975, p. 122, pl. 5, figs. 1-5; Nishikawa, 1991, p. 42, fig. 14.

**Material examined.** 1 spec., 26 July 1995, by divers, 2 m depth.

**Remarks.** The specimens are 27 mm in length and 15 mm in width. The animal is oval, attached to the sea weeds by its whole left side. Branchial aperture is terminal, with 8 lobes and atrial one situated at about one-fourth from the posterior end of the body and with six lobes. The both apertures are moderated size and there are 8 to 6 ocelli at its terminal. Test is thick, cartilaginous and transparent, and the surface is smooth, free from any foreign matter. Mantle is very delicate and



**Figs. 4-6.** *Ascidia gemma* Sluiter, 1895: 4, right side of mantle body, 27 mm long individual; 5, dorsal tubercle, enlarged; 6, left side of mantle body, same specimen.

musculature is a network of fine bundles in the right side.

Inner longitudinal vessels are 30, and transverse vessels are 90 in number, the plication is not and about 7-8 or 3-4 stigmata in each mesh. Tentacles 35 excluding minute ones and dorsal lamina with terminally projection out ribs. Ciliated groove is simple U-shaped. The anterior end of intestinal loop reaches the middle of distance between bases of both siphons and the second intestinal loop is very deep. The anal margin is plain.

Ovary is found in the first intestinal loop and testicular follicles spread over the gut loop on its inner surface.

**Distribution.** Korea (Korea Strait); Japan; China; Australia; Mediterranean Sea; Red Sea, Malay region; West Indian region of America.

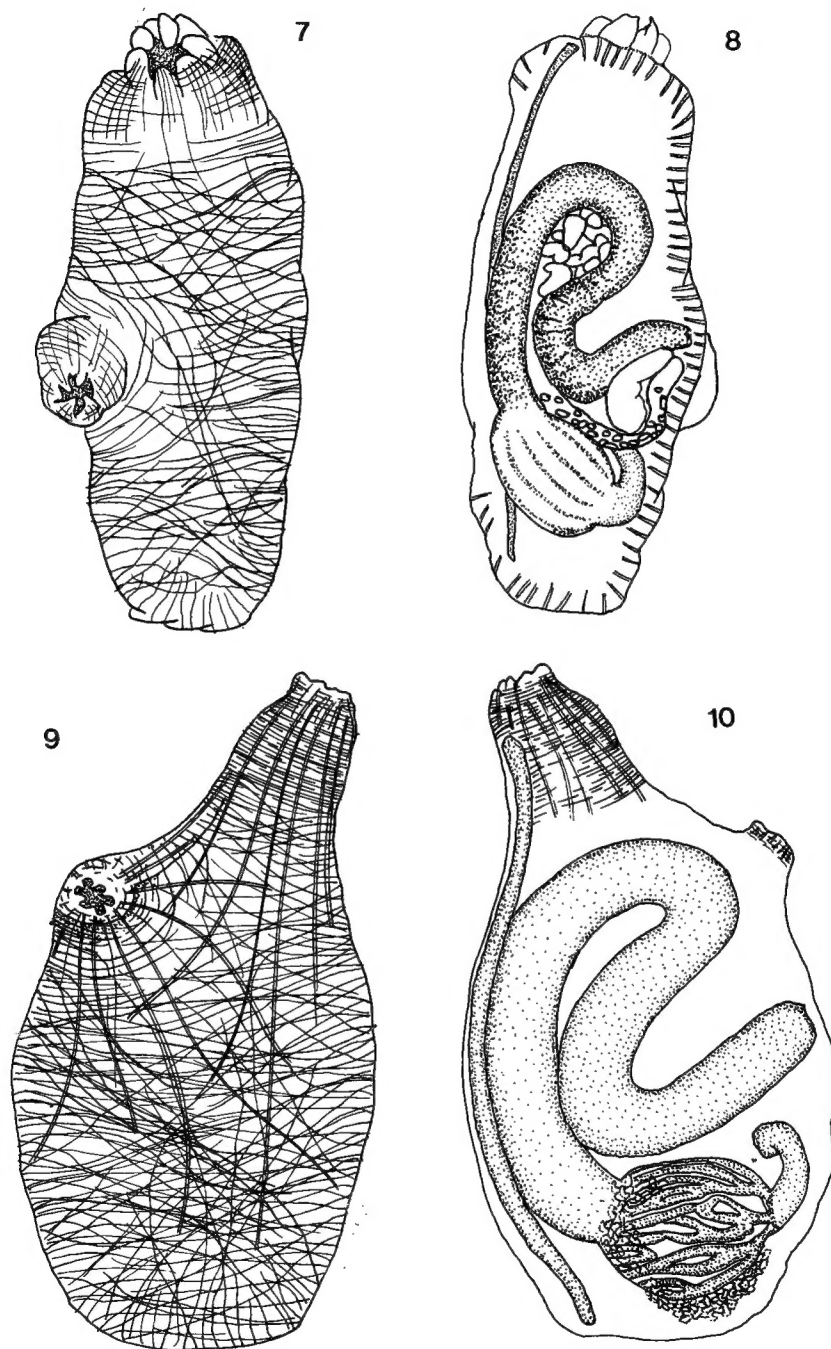
**\*5. *Ascidia zara* Oka, 1935** 자라대추멍게 (신칭) (**Figs. 7-10**)

*Ascidia zara* Oka, 1935, p. 463, figs. 33-34, Tokioka, 1953, p. 222, pl. 33, figs. 1-5, Nishikawa, 1991, p. 52.

*Ascidia? zara*: Miller, 1975, p. 272, fig. 54

**Material examined.** 1 spec., 14 Feb. 1995, by divers, 4 m depth; 2 spec., 26 July 1995, by divers, 2 and 7 m depth.

**Description.** Specimen 28 mm long x 18 mm in width. Body strongly compressed laterally, moderately oval in shape, and attached by entire left side. Test soft and gelatinous, slightly yellowish white or whitend transparent. Branched vessels numerous and completely covered with minute papillae. Mantle very thin, faintly flesh-coloured and feeble musculature on whole right side. Branchial aperture terminal and distinctly eight or six lobed, and atrial aperture about one-third of body length



**Figs. 7-10.** *Ascidia zara* Oka, 1935: 7, right side of mantle body, 30 mm long individual; 8, left side of mantle body, same specimen; 9, right side of mantle body, 28 mm long individual; 10, left side of mantle body, same specimen.

and with six lobed. Both apertures very short and with same numbers of yellowish-orange ocelli (8-6). Banchial sac no plications, tentacles long filiform and about 40-55 in number, beside small and

minute ones. Dorsal tubercle horse-shoes shaped, with both horns curved inwards or straight. Opening turned anteriorly and situated at anterior end of dorsal ganglion. Dorsal lamina ribbed transversely and margin toothed.

Internal longitudinal vessels 35 in number and transverse vessels likewise numerous, 80 mm in large specimen, 3 to 5 stigmata in a mesh and without parastigmatic rows. Intermediate papillae present. Alimentary system occupying greater part of left side. Stomach nearly spherical in shape, globular and with about 12 longitudinal plications on surface of stomach. Intestine bent as in an S shaped, of which second curve open and first intestinal loop wider than second ones. Anus plain margin.

Gonad covered with first intestinal loop and near stomach, and also on its inner side. Oviduct and vas deferens running parallel to rectum.

**Remarks.** The present specimens agree quite well with *Ascidia zara* as described by Tokioka (1953). The original account by Oka (1935) stated that there are no intermediate branchial papillae, but these were noted by Tokioka (1953), and by Nishikawa (1991), there are no intermediate papillae and the fine muscles over the whole side in *A. zara*.

**Distribution.** Korea (Korea Strait); Japan (Hokkaido, Mutu Bay and Kesen in northern Honsyu, Tokyo Bay, Kii-Sirahama, Osaka Bay, Seto Island Sea, 100 to 366 m in depths).

Order Pleurogona Perrier, 1898 측성해초목

Suborder Stolidobranchia Lahille, 1886 강새아목

Family Botryllidae Verrill, 1871 판명계과

#### 6. *Botrylloides violaceus* Oka, 1927 보라판명계

*Botrylloides violaceum* Oka, 1927, p. 608

*Botrylloides violaceum*: Tokioka, 1949, p.7, pl. 3, figs. 5-6; Tokioka, 1953, p. 241, pl. 3, figs. 1-2.

*Botrylloides violaceus*: Tokioka, 1967, p. 158, figs. 63; Rho, 1971, p. 115, pl. 4, fig. 1; Kott, 1985, pl. 279, fig. 136; Nishikawa, 1991, p. 77; Rho, 1995, p. 135.

**Material examined.** one colony, 3 Feb. 1996, by B.J. Rho.

**Remarks.** The colony encrusting *Mytilus* sp. and the system of zooids composed of 9 or 12 and largest ones composed 40, and the numerous orange ampullae are seen between these systems, and the test rather soft, transparent and white, and the living colony is orange in colour.

Zooid attains 1.8-2.2 mm in length, and 0.8-1 mm in width. In the branchial sac 10-12 rows of stigmata on the left, and 12-15 rows of stigmata on the right, and stigmata is D.4, 3, 4, 5, V. or D. 4, 4, 3, 4, V. in a row which they have no more than 16, and second row does not reach median line. Tentacles 15, they are 4 of large size, 5 of middle ones and 6 of small ones, and stomach with 9 complete glandular folds and one incomplete one, and pyloric caecum is small and prominent. Gonads are not appear.

**Distribution.** Korea (East Sea, South Sea, Yellow Sea); Japan; China, Truk and Majuro; Australia; New Zealand; India; East, South Africa.



Family Styelidae Sluiter, 1895 미더덕과

**7. *Dendrodoa aggregata* (Rathke, 1806) 가지명게**

*Ascidia aggregata* Rathke, 1806, p. 11, pl. 130, fig. 2.

*Dendrodoa aggregata*: Van Name, 1945, p. 275, text-figs. 169 and 170 A; Millar, 1966, p. 63, fig. 40; Rho, 1970, p. 147, fig. 4.

**Material examined.** 1 spec., 3 Feb. 1996, by divers, 5 m depth.

**Remarks.** The body's oval, attached to the ventral side, and the both siphons at the upper end. Test is tough and leathery, and the surface is smooth. Mantle body is more or less orange, rather thin, the both apertures are usually scarlet in colour and have four-lobes.

Branchial sac is four folds on each side and inner longitudinal vessels arranged as follows:

Right D. 12, 6, 10, 6, E.

Left D. 13, 8, 8, 6, E.

Tentacles are 50 in number, and the dorsal tubercle is horseshoe-shaped and dorsal lamina is membranous. Alimentary canal occupies the ventral part of the left side, the stomach is globular in shaped, and small pyloric caecum present, and then the anal margin is round and smooth.

The gonad is well developed and expending in a short oviduct, at 5 and spreading more or less irregularly parallel branches state on the right mantle side. Ovary occupies the central part usually surrounded by the testis follicles. There are numerous the larvae, attains 0.8 mm in head and 1.8 mm in tail.

**Distribution.** Korea (East Sea, South Sea, Korea Strait); Bering Sea and Alaska; Aleutian Islands; Kamchatka, Iceland and West Greenland; northern Norway.

**8. *Styela plicata* (Lesueur, 1823) 주름미더덕**

*Ascidia plicata* Lesueur, 1823, pl. 3, fig. b.

*Styela plicata*: Trausted, 1882, p. 123, pl. 5, fig. 6, pl. 6, fig. 16.

For other synonyms see Rho (1995, p.137).

**Material examined.** 16 specs., 26 July 1995, by divers.

**Remarks.** The body moderately elongated, the largest specimen is 65 mm x 28 mm x 23 mm in extent, the smallest ones 40 mm x 13 mm x 11 mm in extent, and attached to the substratum by the posterior end. The branchial aperture is terminal, with short papillae close together at the anterior end, and the atrial ones is a little removed behind.

Test opaque, not very thick, its outer surface with several wrinkles which are mainly longitudinally, and body colour is milky white, but the both apertures with the stripes of silver and reddish in colour. Inner longitudinal vessels are as follows:

Largest one: Right D. 3(22) 2(21) 2(21) 3(16) 3 E.

Left D. 1(22) 2(20) 2(18) 2(14) 2 E.

Smallest one: Right D. 2(14) 2(14) 3(14) 3(12) 3 E.

Left D. 2(16) 1(15) 3(14) 3(13) 2 E.

Three thinner vessels between a pair of the thicker ones, and parastigmatic vessels present, and five or six to seven elongated stigmata in a mesh. Tentacles are not numerous (29 or 37) but of several sizes. Dorsal tubercles simple U shaped, and with anterior ends curled in, and dorsal lamina is

membranous. Stomach rather elongate with numerous longitudinal plication on the surface, and intestinal loop is rather short and anal margin is 12 lobed.

Gonad is well developed, one to two elongate gonad on the left side, four or six to seven on the right side in largest specimen.

**Distribution.** Korea (South Sea, Korea Strait); Japan; Hong Kong.

### 9. *Styela partita* (Stimpson, 1852) 두줄미더덕

*Cynthia partita* Stimpson, 1852, p. 231

*Styela partita*: Berrill, 1932, p. 78; Oka, 1934, p. 184, text-figs. A and B; Van Name, 1945, p. 290, text-fig. 188.

For other references see Rho (1995, p. 136).

**Material examined.** 2 specs., 26 July 1995, by divers, 1-4 m depth.

**Remarks.** The specimen attains 17 mm x 18 mm x 10 mm in extent, attached to the substratum by the ventral side, and dark brown in colour. Both siphones are long, distinct, at the dorsal side and distinguished externally by the alternating stripes of red and white in both apertures.

Test leathery and quite opaque, and mantle is thin. Branchial sac with four folds and inner longitudinal vessels are arranged as follows :

Right D. 3(13) 3(13) 3(14) 4(9) 2 E.

Left D. 2(13) 2(12) 2(13) 3(9) 2 E.

About 7 thinner vessels between a pair of thicker ones. Parastigmatic vessels present, and 5 to 7 stigmata in a mesh. Tentacles 42, composed minute ones. Dorsal lamina is membranous and dorsal tubercle simple, and C-shaped. Stomach is elongate, and with plications and anus margin is 12 lobed.

**Distribution.** Korea (East Sea, South Sea, Korea Strait); Japan; North America; Europe; northwest Africa; West Australia.

### 10. *Styela clava* Herdman, 1881 미더덕

*Styela clava* Herdman, 1881, p. 70.

*Styela clava*: Drasche, 1884, p. 379, taf. b, figs. 9-11.

For other references see Rho (1995, p. 138).

**Material examined.** 43 specs., 26 July 1995, by divers, 1-7 m depth; 6 specs, 3 Feb. 1996, by divers, 2-3 m depth.

**Remarks.** The largest specimen is 80 mm x 22 mm x 15 mm in extent, including the peduncle. Both aperture are 4-lobed and situated terminal. Test leathery, thin but tough, mantle is very thin and delicate, and yellowish white in colour. The inner longitudinal vessels arranged as follows:

Right D. 4(30) 4(25) 5(30) 6(8) 4 E.

Left D. 4(27) 5(33) 5(29) 5(23) 4 E.

Tentacles 30, and dorsal tubercles simple and U-shaped, and with anterior ends curled in. Dorsal lamina is plain.

Gonad is very variable in number, from 1 to 4 on the left mantle side and from 6 to 8 on the right ones, and number of gonads are more numerous on the right than on the left side.

**Distribution.** Korea (East Sea, South Sea, Korea Strait, Yellow Sea); Japan; Bering Sea; Okhotsk Sea; China; Australia; California; Europe.

Family Pyuridae Hartmeyer, 1908 명게과

**11. *Pyura lepidoderma* Tokioka, 1949** 비늘가죽명게

*Pyura lepidoderma* Tokioka, 1949, p. 10, pl. 5, figs. 1-3.

For other references see Rho (1995, p. 139).

**Material examined.** 1 spec., 3 Feb. 1996, by divers, 6 m depth.

**Remarks.** The specimen is small and elliptical, and attached to the substratum by the left side. Test tough, thick and yellowish white in colour, and the surface divided into many scale-like polygonal areas distinctly.

**Distribution.** Korea (South Sea, Korea Strait); Japan; northern Australia.

**12. *Pyura mirabilis* (Drasche, 1884)** 벼개명게

*Cynthia mirabilis* Drasche, 1884, pp. 377-378, taf. 6, figs. 2-7.

*Halocynthia mirabilis*: Oka, 1906, p. 39.

*Pyura mirabilis*: Van Name, 1945, p. 340, fig. 224; Tokioka, 1954, p. 93, pl. 7, fig. 26, p. 8, figs. 27-33; 1959, p. 232.

*Herdmania mirabilis*: Tokioka, 1965, p. 126; 1967, p. 205; Rho, 1971, p. 123, pl. 7, figs. 5-7; 1975, p. 145.

**Material examined.** 1 spec., 26 July 1995, by divers, 4 m depth.

**Remarks.** The specimen is elongate, attains 37 mm x 16 mm x 13 mm in extent, and attached by a large area on the ventral surface. Branchial siphone produced, the atrial very little, and both apertures four lobed. Body colour in the anterior part is orange white and the posterior is yellowish white when alive.

Test rather tough, soft and usually 1-2 mm in thickness. Mantle musculatures well developed on the dorsal part of the body and on the ventral parts of the muscles are less strongly developed and on the left of the muscles are entirely attached to the test.

Branchial sac with six folds on each side and the inner longitudinal vessels are as follows:

Right D. 1(15) 2(10) 1(10) 3(14) 2(14) 2(11) 0 E.

Left D. 0(21) 1(10) 2(9) 3(13) 3(12) 3(9) 1 E.

Six to seven stigmata in a mesh. Tentacles 21, alternating in size, dorsal tubercle C-shaped, with incurved ends, and dorsal lamina is a row of very long languets. Intestinal loop elongate and stomach also elongate, and the surface is distinctly longitudinally plicated.

**Distribution.** Korea (East Sea, Korea Strait); Japan; California.

**13. *Pyura sanderi* (Traustedt and Weltner, 1894)** 매킨이명게

*Cynthia sanderi* Traustedt and Weltner, 1894, p. 11, taf. 11, figs. 1-3.

*Halocynthia sanderi*: Hartmeyer, 1906, pp. 4-5.

*Pyura sanderi*: Tokioka, 1953, p. 275, pl. 67, figs. 1-9, pl. 68, figs. 1-2.

For other synonyms and references see Rho (1975, p. 144).

**Material examined.** 5 specs., 26 July 1995, by divers, 3-4 m depth; 5 specs., 3 Feb. 1996, by divers, 5-6 m depth.

**Remarks.** The largest specimen is 50 mm x 60 mm x 30 mm in extent, and the small one is 40 mm

x 45 mm x 28 mm in extent, and attached to the substratum by the ventral side of the body, and test rather thick, being up to 6mm in thickness.

Branchial sac with six well developed folds on each side and inner longitudinal vessels are as follows:

50 mm long specimen:

Right D. 5(19) 2(24) 3(23) 3(21) 3(20) 3(20) 3 E.

Left D. 6(19) 3(22) 3(25) 4(23) 4(18) 4(12) 2 E.

40 mm long specimen:

Right D. 4(16) 2(20) 2(20) 3(21) 3(18) 3(16) 3 E.

Left D. 4(18) 2(22) 2(22) 3(21) 3(18) 4(12) 2 E.

Two or three thinner transverse vessels inserted between thick ones and seven to eight or seven to nine stigmata in a mesh. Parastigmatic vessels present. Tentacles 21-24, and dorsal tubercle is horseshoe shaped, and has its horns strongly inrolled in large specimens.

One gonad on each side. Each consists of a long tubular oviduct accompanied by a common sperm duct, bearing along each side a series of sausage-shaped sacs, about 17 in the gonad of the right side, and fewer on the left side and is enclosed.

**Distribution:** Korea (East Sea, Korea Strait); Japan.

#### 14. *Halocynthia roretzi* (Drasche, 1884) 멧게 (우렁쉥이)

*Cynthia roretzi* Drasche, 1884, p. 376-377, taf. V, figs. 4-8, taf. VI, fig. 1.

*Cynthis roretzi* f. *typica* + *ivamiana* + var. *sikokiana* Oka, 1927, p. 292, text-figs. a-c.

*Halocynthia roretzi*: Hartmeyer, 1906, p. 16; Oka, 1906, p. 37; Tokioka, 1953, p. 282, pl. 71, figs. 1-4, pl. 72, figs. 1-11, fig. 20; 1954, p. 96; 1967, p. 219; Rho, 1966, p. 214, pl. VIII, figs. 3-5; 1971, p. 126, pl. 11, figs. 1-4; 1991, p. 205, pl. 7, c-d.

**Material examined.** 1 spec., 26 July 1995, by divers.

**Remarks.** The specimen is ovate, attains 50 mm x 35 mm x 30 mm in extent, test tough and leathery. Branchial sac with 12 and 11 folds on right and left side, and inner longitudinal vessels are as follows:

Right D. 0(20) 3(26) 3(35) 3(37) 4(38) 3(38) 3(37) 2(33) 3(25) 4(25) 3(20) 4(6) 2 E.

Left D. 0(27) 3(34) 3(33) 3(38) 3(36) 4(35) 3(35) 3(30) 4(24) 2(22) 2(12) 1 E.

Seven thinner transverse vessels inserted between thick ones and five to six stigmata in a mesh. Tentacles 20 in number. Gonad is elongate and seven tubular gonad on each side.

**Distribution.** Korea (East Sea, Korea Strait); Japan; northern China.

#### 15. *Halocynthia hilgendorfi igaboja* (Oka, 1906) 이가보야개멍게

*Halocynthia igaboja* Oka, 1906, pp. 45-46.

*Halocynthia igaboja*: Van Name, 1945, p. 362.

*Halocynthia hilgendorfi* f. *igaboja*: Tokioka, 1959, p. 233, pl. 17, figs. 38-42; Rho and Lee, 1991, p. 206, pl. 8d.

**Material examined.** 4 specs., 3 Feb. 1996, by divers, 5-7 m depth.

**Remarks.** The specimen attains 60 mm x 45 mm x 38 mm in extent. Test rather thin and the surface is almost completely covered with strait, tapering, thorn-like spines and they attains 5 to 7

mm in length, and a circle of small radiating sharp branches at tip. Branchial sac with eight folds on each side, tentacles 18 in number, and the alimentary tract and gonads resembles that of *Halocynthia roretzi*.

**Distribution.** Korea (East Sea, Korea Strait); Japan; California, British Columbia of American coast.

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## 한국 해산 오수무척추동물의 생물계통학적 연구 — 춘도(온산만) 해초류의 분류 —

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### 적 요

“한국 해산 오수무척추동물의 생물계통학적 연구”의 일환으로서 공업단지로 둘러싸인 온산만의 춘도를 택하여 1995년 2월과 7월, 그리고 1996년 2월에 위 연구의 SCUBA Team에 의해 수심 10 m 미만에서 채집된 해초류를 분류하였다. 그 결과 6과 8속 15종이 밝혀졌으며 이들 중 2종은 한국미기록종이었다. 이들은 *Ascidia sydneyensis* Stimpson(꾸러기대추멍게)와 *Ascidia zara* Oka(자라대추멍게)이며 이들 종에 대하여는 간단한 기재와 그림을 그려 설명하였고 그 외 13종의 기지종에 대하여는 춘도 이외의 지역에서 보고된 기재와 차이가 나는 점을 “특기”로 하여 설명하였다.